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(54) Title: IMPROVED SUPERABSORBENT COMPOSITION AND ABSORBENT ARTICLE USING THE SAME

(57) Abstract: The present invention is directed to a superabsorbent composition comprising: an underneutralized superabsorbent polymer in which at least 30 % of the functional groups of the polymer are in free acid form; and a layered double hydroxide anionic clay. The underneutralized superabsorbent polymer is believed to act as an Na+ trap and the layered double hydroxide anionic clay is believed to act as a Cl- trap, thereby removing the electrolytes from the solution and improving the absorptive capacity of the superabsorbent composition. The preferred types of layered double hydroxide anionic clays useful in the present invention are hydrotalcite clays with rehydrated hydrotalcite being the most preferred. The present invention also discloses an absorbent article comprising the superabsorbent composition.

IMPROVED SUPERABSORBENT COMPOSITION AND ABSORBENT ARTICLE USING THE SAME

FIELD OF THE INVENTION

The present invention relates to a superabsorbent composition. The superabsorbent composition of the present invention is particularly useful in absorbent articles such as disposable diapers, adult incontinence garments, training pants, sanitary napkins, and the like. More particularly, this invention relates to a superabsorbent composition comprising an underneutralized superabsorbent polymer and a layered double hydroxide anionic clay.

BACKGROUND OF THE INVENTION

Commonly, an absorbent article, such as a disposable diaper, adult incontinent garment, training pant, sanitary napkin, or the like, comprises a topsheet which is at least partially liquid pervious, a liquid-impervious backsheet, and an absorbent core formed from (1) cellulosic fibers, which typically are comminuted softwood pulp fibers ("fluff pulp"), and (2) distributed particles of a superabsorbent polymer ("SAP"). The absorbent core is generally positioned between the topsheet and the backsheet. It is also known to provide the absorbent article with one or more other layers formed from cellulosic fibers or other materials to perform various liquid-absorbing, liquid-distributing, and cushioning functions.

Much effort has been expended to find cost-effective materials for absorbent cores which display good liquid absorbency and retention. Superabsorbent polymers in the form of granules, beads, fibers, bits of film, globules, etc., have been favored for such purposes. Such superabsorbent polymers are generally water-insoluble but water-swellable polymeric substances capable of absorbing fluids in an amount which is at least ten times the weight of the substances in their dry form.

In one type of superabsorbent polymer, the particles or fibers may be described chemically as a crosslinked, sodium-neutralized polyacrylate. Included in this class of materials are such modified polymers as sodium-neutralized crosslinked polyacrylates and polysaccharides including, for example, cellulose, starch and regenerated cellulose which are modified to be carboxylated, phosphonoalkylated, sulphoxylated

or phosphorylated, causing the SAP to be highly hydrophilic. Such modified polymers may also be crosslinked to reduce their water solubility.

The water absorption and water retention characteristics of superabsorbent polymers are due to the presence in the polymer structure of ionizable functional groups. These groups are usually carboxyl groups, a high proportion of which are in the salt form when the polymer is dry but which undergo dissociation upon contact with water. In the dissociated state, the polymer chain will have a series of functional groups attached to it which groups have the same electric charge and thus repel one another. This leads to expansion of the polymer structure which, in turn, permits further absorption of water molecules although this expansion is subject to the constraints provided by the cross-links in the polymer structure which must be sufficient to prevent dissolution of the polymer.

It has been found in the past that the absorbent capacity of superabsorbent polymers for body fluids such as urine is dramatically lower than for deionized water. It is generally believed that this effect results from the electrolyte content of body fluids and the effect is often referred to as "salt poisoning". In particular, human urine contains about 0.9 wt % NaCl. These high concentrations of Na+ and Cl- ions disturb the osmotic pressures surrounding the superabsorbent polymer and significantly reduce the absorptive capacity of the superabsorbent polymer in urine relative to its capacity in deionized water. For example the absorption under load ("AUL") at 0.3 psi of a high performance superabsorbent polymer in a saline solution containing 0.9 wt % NaCl is about 30 grams of solution per gram of SAP while the AUL is about 40 grams of solution per gram of SAP and 70 grams of solution per gram of SAP at 0.5 wt % NaCl and 0.1 wt % NaCl, respectively.

Attempts have been made to counteract the salt poisoning effect and improve the performance of superabsorbent polymers in absorbing electrolyte containing liquids such as human urine. A first approach used in the past to increase the absorptive capacity of superabsorbent polymers in NaCl solutions has been directed to the synthesis of superabsorbent polymers which contain ionic functional groups that are not as strongly affected by Na+ ions. However, these approaches have proven costly.

A second approach involves using superabsorbent polymer in combination with anionic/cationic ion exchange resins to remove the NaCl ions. For example, EP-A-0210756 discloses an absorbent structure comprising a superabsorbent polymer and an anion exchanger, optionally together with a cation exchanger, wherein both ion exchangers are in fibrous form. Combining a superabsorbent polymer with an ion exchanger attempts to alleviate the salt poisoning effect by using the ion exchanger, generally as a combination of both an anion exchanger and a cation exchanger, to reduce the salt content of the liquid. The ion exchanger has no direct effect on the performance of the superabsorbent and it may not be possible to reduce the salt content sufficiently to have the desired effect on the overall absorption capacity of the combination. Generally, the anion exchanger is an anion exchange resin containing functional groups in basic form, such as nitrogen containing amine groups, i.e. primary, secondary and tertiary amine groups and quaternary ammonium groups. These ion exchange resins are often expensive and they have no absorbing effect themselves and thus acts as a diluent to the superabsorbent polymer.

Among other things, this invention has resulted from ongoing efforts to improve the absorptive capacity of superabsorbent polymers in electrolyte solutions in a cost effective manner.

SUMMARY OF THE INVENTION

Accordingly, an object of the present invention is to provide an improved superabsorbent composition and an improved absorbent article comprising the same.

Another object of the present invention is to provide a cost-effective superabsorbent composition and an absorbent article comprising the same which has an increased absorptive capacity, particularly in electrolyte solutions.

Accordingly, the present invention is directed to a superabsorbent composition comprising: an underneutralized superabsorbent polymer in which at least 30% of the functional groups of the polymer are in free acid form; and a layered double hydroxide anionic clay. The underneutralized superabsorbent polymer is believed to act as a Na^+ trap and the layered double hydroxide anionic clay is believed to act as a Cl^- trap,

thereby removing the electrolytes from the solution and improving the absorptive capacity of the superabsorbent composition.

This invention is in part premised on the unexpected discovery that certain combinations of underneutralized superabsorbent polymers and layered double hydroxide anionic clays provide superabsorbent compositions with improved absorptive capacity in electrolyte containing solutions, as compared to conventional superabsorbent compositions including costly traditional ion exchange materials. Further, it has been unexpectedly found that lower amounts of layered double hydroxide anionic clay materials can be employed in superabsorbent compositions of the present invention while still attaining superior results, as compared to superabsorbent compositions including conventional ion exchange resins.

The present invention is also directed to an absorbent article comprising: a liquid pervious topsheet; a liquid impervious backsheet joined to said topsheet; an absorbent core positioned between said topsheet and said backsheet; said absorbent core including fluff pulp (or other fibrous material) and a superabsorbent composition of the present invention.

These and other objects, features, and advantages of this invention are evident from the following description of the preferred embodiments of this invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary, perspective view of a disposable diaper exemplifying an absorbent article according to this invention, in an assembled condition.

FIG. 2 is a fragmentary, perspective view of the disposable diaper of FIG. 1, in a flattened condition.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An object of the present invention is to provide a superabsorbent composition with improved performance in the presence of electrolyte, in particular in the presence of NaCl.

The present invention provides a superabsorbent composition which comprises a combination of (1) an underneutralized superabsorbent polymer ("uSAP") in which

at least about 30 % of the functional groups are in free acid form; and (2) a layered double hydroxide anionic clay ("LDH anionic clay").

The uSAP can be any material having superabsorbent properties in which the functional groups are anionic, namely sulphonic groups, sulphate groups, phosphate groups or carboxyl groups. Preferably the functional groups are carboxyl groups. Generally the functional groups are attached to a slightly cross-linked acrylic base polymer. For example, the base polymer may be a polyacrylamide, polyvinyl alcohol, ethylene maleic anhydride copolymer, polyvinylether, polyvinyl sulphonic acid, polyacrylic acid, polyvinylpyrrolidone and polyvinylmorpholine. Copolymers of these monomers can also be used. Starch and cellulose based polymers can also be used including hydroxypropyl cellulose, carboxymethyl cellulose and acrylic grafted starches. Particular base polymers include cross-linked polyacrylates, hydrolyzed acrylonitrile grafted starch, starch polyacrylates, and isobutylene maleic anhydride copolymers. Particularly preferred base polymers are starch polyacrylates and cross-linked polyacrylates.

The uSAP is preferably partially sodium neutralized with sodium hydroxide. Further, preferably less than about 70 % of the functional groups of the uSAP are sodium neutralized and at least about 30 % of the functional groups of the uSAP are in free acid form. More preferably, less than about 50 % of the functional groups of the uSAP are sodium neutralized and at least about 50 % of the functional groups of the uSAP are in free acid form. Most preferably, less than about 40 % of the functional groups of the uSAP are sodium neutralized and at least about 60 % of the functional groups of the uSAP are in free acid form. The term "underneutralized superabsorbent polymer" or "uSAP" as used herein refers to a superabsorbent polymer in which at least about 30 % of the functional groups of the superabsorbent polymer are in the free acid form, as compared to standard superabsorbent polymers wherein the polymer is partially neutralized such that less than about 30 % of the functional groups are in the free acid form.

Additionally, the uSAP of the present invention preferably has a pH of less than about 6.0 and more preferably has a pH ranging from about 4.5 to about 6.0.

The LDH anionic clays useful in the present invention are bimetallic compounds containing a reactive interlayer capable of binding and exchanging anions. LDH anionic clays are made of layers of metal cations (M2+ and M3+) of similar ionic radii, which are coordinated octahedrally by six oxygen anions. They form two-dimensional sheets and which may stack together by hydrogen bonding between the hydroxyl groups of adjacent sheets. LDH anionic clays incorporate charge balancing anions such as CO32-, NO3-, or OH- between adjacent layers in the reactive interlayer in order to maintain electrical neutrality. LDH anionic clays can serve as anionic exchange materials through the exchange of these interlayer anions. The reactive interlayer can also contain water when the LDH anionic clay is hydrated.

The preferred types of LDH anionic clays of the present invention are hydrotalcite-like anionic clays. Hydrotalcite-like anionic clays include hydrotalcite, manasseite, pyroaurite, sjögrenite, stichtite, barbertonite, takovite, reevesite, and desuatelsite, with hydrotalcite being more preferred and hydrotalcite in its rehydrated form (50 % moisture content) being most preferred.

It has now surprisingly been found according to the present invention that a combination of uSAP with LDH anionic clay is particularly effective as a superabsorbent composition in the case of electrolyte containing solutions, for example human urine. Further, it has unexpectedly been found that the synergistic effect of the uSAP and the LDH anionic clay in the superabsorbent composition of the present invention results in a more effective and less costly superabsorbent material, as compared to superabsorbent compositions containing standard superabsorbent polymer and traditional, basic anion exchange materials.

While not wishing to be bound by any particular theory, it is believed that there is a two fold effect when the superabsorbent composition according to the present invention is contacted with an electrolyte containing solution as follows:

(1) the uSAP provides cation (Na+) exchange properties, binding Na+ and thereby deionizing the solution; and

(2) the LDH anionic clay provides anion (Cl-) exchange properties, binding. Cl- and thereby deionizing the solution.

The functional groups in uSAP are typically carboxyl groups which act as a weak acid which does not dissociate when placed, for example, in a sodium chloride solution. However, presence of the LDH anionic clay has the effect of attaching chloride ions from sodium chloride solution, thereby displacing the equilibrium in favor of conversion of the uSAP into the salt form, thereby converting the uSAP into a high performance superabsorbent polymer in situ.

This conversion of the uSAP into the salt form on contact with an electrolyte containing solution and the effect of the LDH anionic clay in binding chloride ions has a significant desalting effect on the solution, thereby improving the performance of the superabsorbent by alleviating the salt-poisoning effect. In contrast with the use of an ion-exchange resin to desalt the solution in combination with a superabsorbent which is already in salt form (see EP-A-0210756 referred to above), the uSAP also has a desalting effect on the solution. This allows a much greater desalting effect to be achieved than by use of ion exchanger and a traditional superabsorbent polymer in salt form. It should be noted that the effect of the electrolyte in solution on the absorption capacity of a superabsorbent polymer for that solution is not linear in that absorption capacity does not decrease regularly with increasing salt content. Accordingly over certain concentration ranges it is possible to bring about a relatively large increase in absorption capacity by effecting a relatively small reduction in salt content of the solution.

The superabsorbent composition of the present invention generally contains uSAP and LDH anionic clay in a ratio ranging from about 1:1 to about 1:20, preferably from about 1:1 to about 1:10, and most preferably from about 1:1 to about 1:4.

The present invention also relates to an absorbent article using the above described superabsorbent composition. As shown in FIGS. 1 and 2, an absorbent article according to the invention may be in the form of a disposable diaper 10. More particularly, the disposable diaper 10 may be appropriately sized for infant use or for adult use. If sized for adult use, the disposable diaper 10 may be also called an incontinent garment. It may be here noted that this invention may be also embodied in

a wound dressing or another absorbent article known in the art other than a disposable diaper, e.g., training pant, adult incontinence garment, sanitary napkin, or the like.

A disposable diaper 10 of the present invention generally comprises a liquid pervious topsheet 12, a liquid impervious backsheet 14 joined to the topsheet 12, and an absorbent core 16 positioned between the topsheet 12 and said backsheet 14. The disposable diaper 10 can further include tape fasteners 18, elasticized waistbands 20, and other features well known to those skilled in the art. The topsheet 12 and the backsheet 14 may be bonded adhesively around outer edges 22 of the disposable diaper 10, in a known manner, so as to contain the absorbent core 16. The topsheet 12, also called a facing sheet, may be made from polymeric fibers such as polyolefins. The backsheet 14 may be made from a synthetic polymeric film, such as a polyethylene film.

Except as illustrated and described herein, the disposable diaper 10 may be substantially similar to the disposable diaper disclosed in Huffman et al. U.S. Patent No. 5,403,301, or in Chmielewski U.S. Pat No. 5,891,120, both assigned to the assignee of the present invention, the disclosures of which are incorporated herein by reference in a manner consistent with this disclosure. In the embodiment shown in FIG. 2, absorbent core 16 can include an central absorbent structure 32 with an elongate, central portion 40 with a front end 42 and a back end 44, along with two ears 46 near the front end 44.

In one embodiment, the absorbent core 16 can comprise (1) cellulosic fibers, which typically are comminuted softwood pulp fibers ("fluff pulp") or other fibrous material, and (2) distributed particles of the superabsorbent composition of the present invention.

The superabsorbent composition of the present invention can be distributed within the absorbent core by any method known in the art, and can be used as the only superabsorbent material in the absorbent core or as an additive to standard superabsorbent polymers. The superabsorbent composition of the present invention should be present in the absorbent core in an amount ranging from about 1 gram to about 20 grams of superabsorbent composition per gram of fluff pulp. Preferably, the superabsorbent composition is present in the absorbent core in an amount ranging

from about 1 gram to about 10 grams per gram of fluff pulp, and more preferably from about 1 gram to about 5 grams per gram of fluff pulp.

The following examples are designed to illustrate particular embodiments of the present invention and to demonstrate the efficacy of the superabsorbent composition and absorbent articles of the present invention as compared to conventional superabsorbent materials and absorbent articles.

In general, some of the most important performance attributes of an absorbent core of a diaper (or any other absorbent garment) are functional capacity, rate of absorption, and core stability in use. Absorption under load ("AUL") of the core is a good measure of functional capacity and the rate at which that absorption occurs. Therefore, AUL values will be used in the following illustrative and comparison examples.

EXAMPLE 1:

A series of simulated absorbent core materials were tested and the AUL values (under a pressure of 0.5 psi) were determined to demonstrate the efficacy of the present invention. The AUL tests were performed in a standard test cylinder by first placing therein a circular (50 mm) weighed sample of a standard pulp fiber (600 mg) sheet. The upper surface of the circular pulp fiber sheet was then evenly sprinkled with a weighed amount of a superabsorbent composition comprising uSAP and ion exchange material as indicated in Table 1. A second weighed pulp fiber (600 mg) sheet was placed on top of the superabsorbent composition and a stainless steel cylinder fitted with a 40 mesh stainless steel screen at one end was then placed on the pulp-superabsorbent composition-pulp sandwich, with the screen in contact with the uppermost pulp layer. A cylindrical weight exerting a pressure of 0.5 psi was then placed on the open end of the stainless steel cylinder. Thereafter, synthetic urine (a 0.87 % w/w sodium chloride solution, 50 g) was poured into the stainless steel cylinder and allowed to absorb though the 40 mesh stainless steel screen for 20 minutes. The synthetic urine above the screen was then collected with an eye-dropper and weighed to determine by difference the amount of synthetic urine absorbed by the simulated absorbent core.

The superabsorbent compositions evaluated were as follows:

Comparative Sample 1: No ion exchange materials and 600 mg of SAP IM 4500 (Hoechst Celanese Corp.) - a crosslinked polyacrylic acid with an estimated 65 % of the functional groups neutralized with sodium hydroxide and an estimated 35 % of the functional groups in free acid form.

Comparative Sample 2: 7.5 g of Dowex 50W-X8 - a conventional strongly acidic ion exchange material; 7.5 g of Amberlite IRA-400 - a conventional strongly basic ion exchange material; and 600 mg of SAP IM 4500.

Comparative Sample 3: 7.5 g of Dowex 1-X8 - a convention strongly basic ion exchange material; and 600 mg of SAP IM 4500.

Sample 1: 7.5 g of rehydrated FloMag HAC-P (Martin Marietta Magnesia Specialties Inc., Baltimore MD) - a rehydrated hydrotalcite material; and 600 mg of SAP IM 4500.

Sample 2: 7.5 g of rehydrated FloMag HAC-P; and 600 mg of HSAP 40 - a crosslinked polyacrylic acid with an estimated 40 % of the functional groups neutralized with sodium hydroxide and an estimated 60 % of the functional groups in free acid form.

NOTE: the hydrotalcite used in Samples 1 and 2 was rehydrated by soaking dry hydrotalcite in deionized water overnight. The unabsorbed water was decanted and the remaining solid patted dry (50 % moisture content) on a paper towel.

Table 1

Sample No.	Superabsorbent Polymer Type	Ion Exchange Material Type	Ion Exchange Material (g)	AUL Value (g/g)
Comparative 1	SAP IM 4500 - 35 % Free Acid	n/a	n/a	14.30
Comparative 2	SAP IM 4500 - 35 % Free Acid	Dowex 50W-X8 / Amberlite IRA-400	7.5 (H+) / 7.5 (OH-)	18.60
Comparative 3	SAP IM 4500 - 35 % Free Acid	Dowex 1-X8	7.5	18.14
1	SAP IM 4500 - 35 % Free Acid	FloMag HAC-P - rehydrated	7.5	19.19
2	HSAP-40 - >35 % Free Acid	FloMag HAC-P - rehydrated	7.5	19.28

As the results in Table 1 demonstrate, it was unexpectedly found that the combination of a preferred LDH anionic clay with either a SAP comprised of an estimated 35 % (Sample 1) or an estimated 60 % (Sample 2) free acid content results in surprisingly superior AUL values when compared to superabsorbent compositions containing a uSAP alone (Comparative Sample 1).

EXAMPLE 2:

A series of simulated absorbent core materials were tested and the time dependent AUL values (under a pressure of 0.5 psi) were determined to compare the performance of uSAP materials with varying degrees of sodium neutralization in combination with anionic exchange materials. The AUL tests were performed in a standard test cylinder as described in Example 1.

The superabsorbent compositions evaluated were as follows:

Comparative Sample 4: 7.5 g of Dowex 1-X8 - a convention strongly basic ion exchange material; and 600 mg of SAP IM 4500 (Hoechst Celanese Corp.) - a crosslinked polyacrylic acid with an estimated 65 % of the functional groups neutralized with sodium hydroxide and an estimated 35 % of the functional groups in free acid form or 600 mg of HSAP 40 - a crosslinked polyacrylic acid with an estimated 40 % of the functional groups neutralized with sodium hydroxide and an estimated 60 % of the functional groups in free acid form - as indicated.

Sample 3: 7.5 g of rehydrated FloMag HAC-P (Martin Marietta Magnesia Specialties Inc., Baltimore MD) - a rehydrated hydrotalcite material; and 600 mg of SAP IM 4500 or 600 mg of HSAP 40 - as indicated.

Sample 4: 4.0 g of rehydrated FloMag HAC-P; and 600 mg of SAP IM 4500 or 600 mg of HSAP 40 - as indicated.

NOTE: the hydrotalcite used in Samples 1 and 2 was rehydrated by soaking dry hydrotalcite in deionized water overnight. The unabsorbed water was decanted and the remaining solid patted dry (50 % moisture content) on a paper towel.

Table 2

Exposure Time (h)	Comparative Sample 4 AUL (g/g) Dowex 1-X8 (7.5g)		Sample 3 AUL (g/g) FloMag HAC-P (7.5 g)		Sample 4 AUL (g/g) FloMag HAC-P (4.0 g)	
	SAP	HSAP	SAP	HSAP	SAP	HSAP
0.5	18.14	18.00	19.19	19.28	17.93	17.73
1	18.93	18.27	19.63	19.67	18.64	18.40
2	19.12	18.30	19.66	20.15	19.15	19.11
4	19.34	18.62	20.11	21.15	19.48	19.96

As Table 2 shows, the superabsorbent composition of the present invention out performs a comparative superabsorbent composition containing conventional anionic exchange materials both initially and during an extended time frame. Further, as Sample 4 demonstrates, significantly lower amounts of LDH anionic clay can be used, as compared to conventional anionic exchange materials, while still attaining comparable results in an extended time frame.

Table 2 also demonstrates the surprising synergistic effects of combining a uSAP material with an LDH anionic clay material. For instance, when the HSAP material (uSAP with a greater percentage of functional groups in the free acid form) was used in combination with the hydrotalcite material, AUL values showed a slight improvement over the course of an extended time frame. However, when the HSAP material was used in combination with a conventional anionic exchange material, no such improvement was found. In fact, the AUL values slightly decreased with the increasing percentage of functional groups in the free acid form in the comparative sample.

EXAMPLE 3:

A series of simulated absorbent core materials were tested and the time dependent AUL values (under a pressure of 0.5 psi) were determined to compare the performance of various types of LDH anionic clay materials in a dry form and in a rehydrated form. The AUL tests were performed in a standard test cylinder as described in Example 1.

The superabsorbent compositions evaluated were as follows:

Sample 5: 2.0 g of FloMag 42 (Martin Marietta Magnesia Specialties Inc., Baltimore MD) - a hydrotalcite material - in dry and rehydrated form as indicated ; and 600 mg of SAP IM 4500 (Hoechst Celanese Corp.) - a crosslinked polyacrylic acid with an estimated 65 % of the functional groups neutralized with sodium hydroxide and an estimated 35 % of the functional groups in free acid form.

Sample 6: 2.0 g of FloMag 42A (Martin Marietta Magnesia Specialties Inc., Baltimore MD) - a hydrotalcite material - in dry and rehydrated form as indicated; and 600 mg of SAP IM 4500.

Sample 7: 2.0 g of FloMag 02 (Martin Marietta Magnesia Specialties Inc., Baltimore MD) - a hydrotalcite material - in dry and rehydrated form as indicated; and 600 mg of SAP IM 4500.

NOTE: the hydrotalcite used in Samples 1 and 2 was rehydrated by soaking dry hydrotalcite in deionized water overnight. The unabsorbed water was decanted and the remaining solid patted dry (50 % moisture content) on a paper towel.

Table 3

Exposure Time (h)	Sample 5 AUL (g/g) FloMag 42 (2 g, dry)		Sample 6 AUL (g/g) FloMag 42A (2 g, dry)		Sample 7 AUL (g/g) FloMag 02 (2 g, dry)	
	non-hydrated	re-hydrated	non-hydrated	re-hydrated	non-hydrated	re-hydrated
0.5	14.85	15.37	15.98	16.93	15.87	15.16
1	15.10	15.80	16.44	17.38	16.33	15.61
2	15.43	16.05	16.90	17.83	16.80	15.98
4	15.73	16.50	17.80	18.40	17.23	16.58

As demonstrated in Table 3, the rehydrated form of certain hydrotalcite materials generally result in higher AUL values as compared to hydrotalcite materials in the dry form. Table 3 also shows that a particularly preferred type of LDH anionic

clay material useful in the present invention is rehydrated FloMag 42A. Further, Table 3 demonstrates that superabsorbent compositions of the present invention are effective even at relatively low levels of LDH anionic clay materials.

EXAMPLE 4:

A series of simulated absorbent core materials were tested and the time dependent AUL values (under a pressure of 0.5 psi) were determined to evaluate the efficacy of a particularly preferred superabsorbent composition of the present invention and to demonstrate the dependence of AUL values on LDH anionic clay material levels. The AUL tests were performed in a standard test cylinder as described in Example 1.

The superabsorbent compositions evaluated were as follows:

Comparative Sample 5: no ion exchange materials; and 600 mg of SAP IM 4500 (Hoechst Celanese Corp.) - a crosslinked polyacrylic acid with an estimated 65 % of the functional groups neutralized with sodium hydroxide and an estimated 35 % of the functional groups in free acid form.

Sample 8: 0.5 g of rehydrated FloMag 42A (Martin Marietta Magnesia Specialties Inc., Baltimore MD) - a rehydrated hydrotalcite material; and 600 mg of SAP IM 4500.

Sample 9: 1.0 g of rehydrated FloMag 42A; and 600 mg of SAP IM 4500.

Sample 10: 2.0 g of rehydrated FloMag 42A; and 600 mg of SAP IM 4500.

Table 4

Exposure Time (h)	Comp. Sm. 5 no rehydrated FloMag 42A	Sample 8 rehydrated FloMag 42A (5 g)	Sample 9 rehydrated FloMag 42A (1 g)	Sample 10 rehydrated FloMag 42A (2 g)
0.5	19.82	20.36	21.36	22.58
1	20.54	21.29	22.22	23.46
2	20.95	21.48	22.65	23.71
4	21.59	21.66	23.13	23.95

As shown in Table 4, the AUL values of a preferred embodiment of the present invention increase with increasing amounts of rehydrated FloMag 42A. Further, even at levels as low as 0.5 g, the superabsorbent compositions of the present invention outperform conventional superabsorbent compositions.

Although the invention has been described in connection with the preferred embodiments, these embodiments are not intended to limit the invention Those skilled in the art will readily appreciate that various modifications may be made to the preferred embodiments without departing from the scope and spirit of the invention as defined by the appended claims.

CLAIMS

What is claimed is:

1. A superabsorbent composition comprising:

   an underneutralized superabsorbent polymer in which at least 30% of the functional groups of the polymer are in free acid form; and

   a layered double hydroxide anionic clay

2. The composition of claim 1 wherein the underneutralized superabsorbent polymer has a pH ranging from about 4.5 to about 6.0

3. The composition of claim 1 wherein less than about 70 % of the functional groups of the underneutralized superabsorbent polymer are sodium neutralized and at least 30 % of the functional groups of the underneutralized superabsorbent polymer are in free acid form.

4. The composition of claim 1 wherein less than about 50 % of the functional groups of the underneutralized superabsorbent polymer are sodium neutralized and at least 50 % of the functional groups of the underneutralized superabsorbent polymer are in free acid form.

5. The composition of claim 1 wherein about 40% of the functional groups of the underneutralized superabsorbent polymer are sodium neutralized and at least 60 % of the functional groups are in free acid form.

6. The composition of claim 1 wherein the layered double hydroxide anionic clay is hydrotalcite.

7. The composition of claim 6 wherein the hydrotalcite is rehydrated.

8. The composition of claim 1 wherein the underneutralized superabsorbent polymer and the layered double hydroxide anionic clay are present in a ratio ranging from about 1:1 to about 1:20.

9. The composition of claim 1 wherein the underneutralized superabsorbent polymer and the layered double hydroxide anionic clay are present in a ratio ranging from about 1:1 to about 1:10

10. An absorbent article comprising:

a liquid pervious topsheet;
a liquid impervious backsheet joined to said topsheet;
an absorbent core positioned between said topsheet and said backsheet;
said absorbent core including fluff pulp and a superabsorbent composition;
said superabsorbent composition comprising an underneutralized superabsorbent polymer and a layered double hydroxide anionic clay wherein at least 30% of the functional groups of the underneutralized superabsorbent polymer are in free acid form.

11. The absorbent article of claim 10 wherein the superabsorbent composition is present in an amount ranging from about 0.2 gram to about 0.8 grams per gram of fluff pulp in the absorbent core.

12. The absorbent article of claim 10 wherein the superabsorbent composition is present in an amount ranging from about 3 gram to about 10 grams per gram of fibrous material in the absorbent core.

13. The absorbent article of claim 10 wherein the underneutralized superabsorbent polymer has a pH ranging from about 4.5 to about 6.0

14. The absorbent article of claim 10 wherein less than about 70 % of the functional groups of the underneutralized superabsorbent polymer are sodium neutralized and at least 30 % of the functional groups of the underneutralized superabsorbent polymer are in free acid form.

15. The absorbent article of claim 10 wherein less than about 50 % of the functional groups of the underneutralized superabsorbent polymer are sodium neutralized and at least 50 % of the functional groups of the underneutralized superabsorbent polymer are in free acid form

16. The absorbent article of claim 10 wherein about 40% of the functional groups of the underneutralized superabsorbent polymer are sodium neutralized and at least 60 % of the functional groups are in free acid form

17. The absorbent article of claim 10 wherein the layered double hydroxide anionic clay is hydrotalcite.

18. The absorbent article of claim 17 wherein the hydrotalcite is rehydrated

19. The absorbent article of claim 10 wherein the underneutralized superabsorbent polymer and the layered double hydroxide anionic clay are present in a ratio ranging from about 1:1 to about 1:20

20. The absorbent article of claim 10 wherein the underneutralized superabsorbent polymer and the layered double hydroxide anionic clay are present in a ratio ranging from about 1:1 to about 1:10.

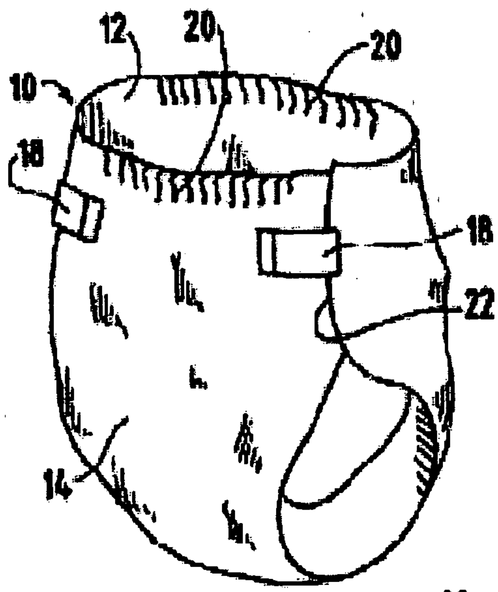

FIG. 1

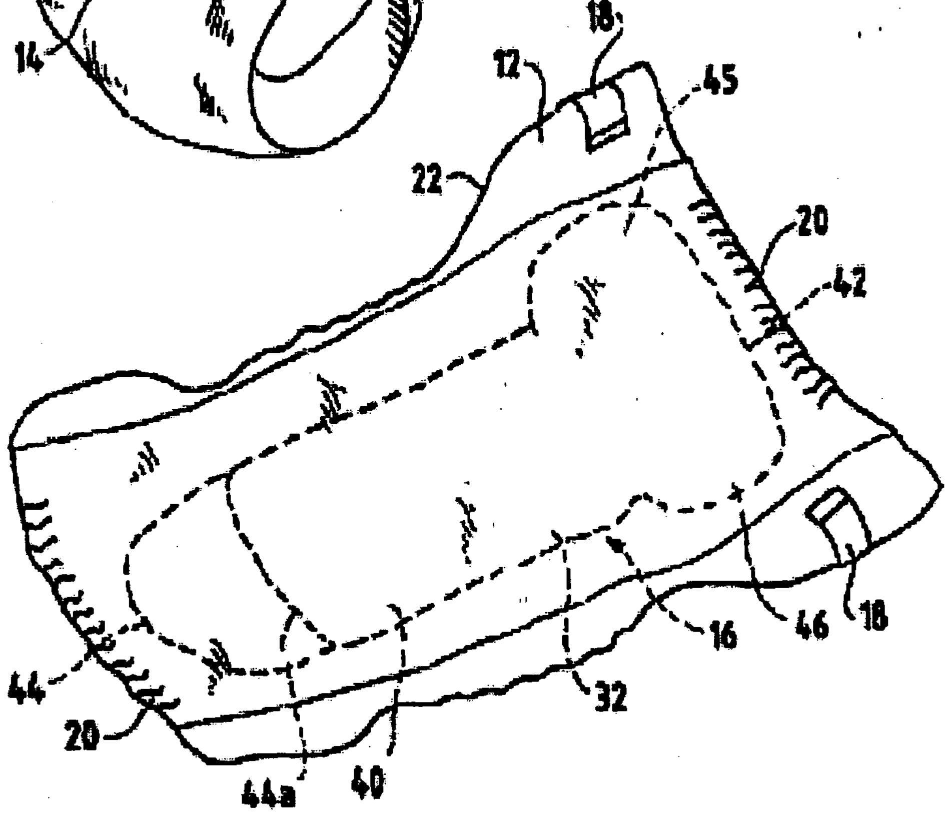

FIG. 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/30240

A. CLASSIFICATION OF SUBJECT MATTER
IPC(7) : A 61 F 13/15, 13/20
US CL : 604/367, 372; 525/217,328,362;442/375
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 604/367, 372; 525/217, 328, 362; 442/375

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,821,179 A (MASAKI et al.) 13 OCTOBER 1998, see entire document	1-20
A, P	US 6,072,101 A (BEIHOFFER et al) 06 JUNE 2000, col. 6, line 62 to col. 14, line 46	1-20
Y, P	US 6,087,448 A (MITCHELL et a.l) 11 JULY 2000, col. 3, lines 14-51	1-5, 10-16
Y	US 5,865,410 A (CARRICO et al.) 05 JANUARY 1999, col. 3, line 16 to col. 4, line 54	1-5, 10-16

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

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